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## "THE ENTOMOLOGIST"

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TRANSACTIONS OF THE SOCIETY FOR BRITISH ENTOMOLOGY

VOL. 16 DECEMBER 1964 PART IV

# The Plecoptera of the Moor House National Nature Reserve, Westmorland

By V. M. Brown*, J. B. Cragg and D. T. Crisp

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Apart from a general survey of the Tees by Butcher, Longwell and Pentelow (1937), little attention has been paid to the fresh water fauna of the northern Pennines. The present study, eonfined to the Plecoptera, was undertaken as a first step towards filling this gap. The Pleeoptera were seleeted for speeial investigation partly beeause the taxonomy of both the adult and aquatie stages has received very thorough treatment (Hynes 1940, 1941, 1958) and also beeause they form a dominant part of the fauna of upland streams.

The field investigations were eonfined to the Moor House National Nature Reserve (Nat. Grid ref. NY 758329) whieh has been deseribed by Conway (1955), Cragg (1961) and Johnson and Dunham (1963). The last two publieations eontain maps whieh name the various sites referred to in this paper. An important part of the head-waters of the Tees lies within the Reserve and this with adjaeent areas of the Pennines, forms a water eateh-ment of eonsiderable biological and eeonomie importanee.

General eolleetions of Pleeoptera nymphs were made during the period November 1951-July 1954 using a Surber sampler (Weleh, 1955) and by taking ten-minute samples with a pond net. Frequent eolleetions of imagines were made from beneath stones on stream banks and from unsubmerged stones in streams during 1952 and 1953. At intervals sinee 1953, work has been eoneen-trated on the general fauna of the freshwaters and published information is available for the Cladoeera (Heal, 1963), Corixidae (Crisp, 1962), Simuliidae (Phillipson, 1957; Davies & Smith, 1958) and for fish (Crisp, 1963).

## I. Water Bodies, Climate and Aquatic Vegetation

A general deseription of bodies of standing water on and near the Reserve is given by Crisp (1962) and Crisp (1963) gives a brief description of some typical stream stretehes on the eastern side of the Reserve. The streams of the western side of the Reserve are tributaries of the River Eden and are torrential throughout most of their passage through the Reserve. The

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streams of the eastern watershed flow into the River Tees. They have a slower rate of fall than the streams of the western watershed, but during flood conditions become torrential throughout their lengths. Estimates of water velocity made by timing floating debris and by use of a Pitot tube during floods approximated 1·5 m./sec. and Phillipson (1957) recorded current velocities of up to 1·25 m./sec. in Trout Beck during 1955.

The climate of the Reserve was described by Manley (1942) as sub-arctic. Climatic factors most likely to influence Plecoptera during aquatic life-stages are large variations in the total amount and the rate of precipitation, low temperatures and the high proportion of cloud-cover. During the imaginal stage the frequency of strong winds becomes an important factor, along with the heavy rainfall, prolonged cloud-cover and frequent occurrence of mist. Precipitation amounts to 70-80 in. (180-200 cm.) annually and about 15% falls as snow. The relative humidity rarely falls below 60% RH and the monthly mean is rarely less than 80%. Temperatures remain at a low level most of the year. The average summer air temperature is a little above 10° C. and temperatures at or below freezing point occur during nine months of the year. Davies and Smith (1958) quote water temperature records for a stream on the western side of the Reserve. Gorham (1956) and Crisp (1963) give analyses of stream waters from the Reserve.

The flora of the streams consist almost solely of bryophytes and sessile algae although *Equisetum fluviatile* L. develops, with other non-hydrophytes, along the stream edges during summer. Within the vicinities of the sources of some of the streams, and below springs on limestone, flush vegetation may occur. This may include *Ranunculus hederaceus* L., *Nasturtium officinale* R. Br., *Caltha palustris* L., *Chrysosplenium oppositifolium* L., and *Carex* spp. The bryophyte vegetation in these areas is often dense and includes *Polytrichum commune* Hedw., various *Sphagnum* spp., *Hypnum* spp. and *Scapania* spp.

In general, rooted plants are absent from the largely unstable main stream-courses. Bryophytes form the most important permanent vegetative growths, *Fontinalis antipyretica* Hedw. and *Eurhynchium riparioides* (Hedw.) being particularly common on stable parts of the substratum. In the lower reaches, the amount of attached moss decreases. Considerable quantities of discrete plant-remains such as *Calluna* shoots occur wedged beneath stones in the lower unstable reaches, forming an important habitat in areas otherwise free of macro-vegetation. The sessile algae, which form an important part of the economy of the streams, show a marked periodicity in abundance, the stones becoming covered with a dense algal 'carpet' at certain times of the year, provided that flooding is not too frequent. A short period of flooding, even when growths are densest, results in the removal of most of the algal masses. Butcher *et al.* (1937) list the algal species found at Trout Beck foot and in the lower reaches of the Tees.

## II. Plecoptera recorded within the Moor House National Nature Reserve

Most observations and records at Moor House were made on the eastern watershed of the Reserve between 1600 and 2700 ft. (490-735 m.) O.D. for which the flight period data principally apply. The species comprise seven Setipalpia (1-7) and eighteen Filipalpia (8-25). Kimmins (1950) listed 34 species of Plecoptera for the British Isles. Of these, twenty-five have been recorded in the present study within an area of 10,000 acres (4,000 hectares). Four of these species, *Capnia vidua* Klap., *Leuctra moselyi* Mort., *Protonemura montana* Kimm., *Amphinemura standfussi* Ris., have been described by Hynes (1940) and Kimmins (1950) as rare for Britain. The nine species not recorded at Moor House have distributions or habitat preferences which make it unlikely that they will be found in upland areas of the northern Pennines. The nomenclature used in the following list is according to Hynes (1958). Those species recorded from the Tees by Butcher *et al.* (1937) are shown by *. They also recorded *Leuctra geniculata* (Steph.), *Capnia* spp. and *Nemoura* spp.

### Family Perlodidae

1. *Perlodes microcephala* (Pietet)*. Common: at least to 2300 ft. (700 m.) O.D. In streams. Among large stones and boulders. Upper limit dictated by stream conditions (adequate flow and suitable substratum) rather than by altitudinal factors. Flight period: April to June inclusive. British records: March to July inclusive.

2. *Diura bicaudata* (Linné). Common: up to 2400 ft. (730 m.). More numerous above the limits of *P. microcephala* in any particular stream. Among stones and boulders, common in moss. Areas with relatively slow flow-rate and small volume of flow, with a minimum of temperature fluctuations. Flight period: April to June. British records: April to August.

### Family Perlidae

3. *Dinocras cephalotes* (Curtis)*. Frequent: below 1700 ft. (520 m.) O.D. Among large stones and stable boulders in adequate flow or volume of water in the Tees and, along with *Perla bipunctata*, in the streams of the western escarpment. Flight period: not observed.

4. *Perla bipunctata* (Pictet)*. Common: up to 1900 ft. (580 m.) O.D., but normally only in the larger parts of stream watercourses (the lower reaches) where the flow is adequate. In Trout Beck; and the Tees on stable and unstable substrata; beneath boulders in fast current (above 1·0 m./sec.) though present in slightly slower flow also. More numerous and widespread than *D. cephalotes*. Flight period: June. British records: April to June.

5. *Isoperla grammatica* (Poda)*. Frequent on the eastern slopes, common on the western slopes; up to 2400 ft. (730 m.) O.D. at least. Generally occurring among pebbles, stones, boulders and moss where flow adequate in streams. Flight period: May to July. British records: April to August.

6. *Chloroperla torrentium* (Pictet)*. Abundant: up to 2400 ft. (730 m.) O.D. at least. Present in all streams examined on the Reserve amongst stones, boulders, gravel and sand (mixed deposits) and moss. Flight period: May to July. British records: April to August.

7. *Chloroperla tripunctata* (Scopoli)*. Rare: nymph only taken once (towards the upper reaches of Moss Burn amongst pebbles, stones and boulders at 1940 ft. (i.e. 590 m.) O.D. Flight period: not observed.

Family Taeniopterygidae

8. *Taeniopteryx nebulosa* (Linné)*. Frequent: up to 2200 ft. (670 m.) O.D. at least. Beneath large stones and boulders in most of the streams, and in sluggish 'back-waters'. The young stages are present among moss on boulders, the older nymphs on discrete plant-remains beneath boulders. Most numerous in sluggish waters such as outflows from disused mine drifts. Flight period: March-May. British records: February to April.

9. *Brachyptera risi* (Morton)*. Rare: nymphs only taken once in the lowest reach of Moss Burn 1800 ft. (550 m.) O.D. Flight period: not observed.

Family Capniidae

10. *Capnia vidua* Klapalek. Common: present in all streams above 1600 ft. (490 m.) O.D. On all substrata (stony, peaty or mossy). The only species recorded on bare peat-detritus (at junction of limestone spring and stream). Most numerous in pools with slow flow and bottoms of sand or gravel with occasional pebbles. Also present beneath stones in trickles on eroding peat. Flight period: March, April, May. British records: March, April.

Family Leuctridae

11. *Leuctra nigra* (Olivier). Frequent: up to the stream headwaters. (This estimate of abundance is based on adult captures). Nymphs rarely taken; those taken occurred mainly among pebbles, stones and boulders. Flight period: April-June. British records: April-August.

12. *Leuctra inermis* Kempny*. Abundant throughout the altitudinal range of the Reserve. Among gravel, pebbles, stones and boulders in all streams. The most numerous species on the Reserve. Flight period: April to July. British records: April to August.

13. *Leuctra fusca* (Linné)*. Abundant in streams throughout the altitudinal range of the Reserve. Somewhat less numerous than *L. inermis* which it replaces during the summer months. Flight period: June to October. British records: June to December.

14. *Leuctra hippopus* (Kempny). Common: in almost all running waters of the Reserve during the autumn and winter months, in habitats ranging from eroding peat and mossy trickles to pebbles and stones of the larger streams. Flight period: March to May. British records: February to June.

15. *Leuctra moselyi* Morton. Abundant: occurring along with *L. fusca* during summer. Flight period: June to October. British records: July, August.

Family Nemouridae

16. *Protonemura meyeri* (Pictet)*. Common: at least to 2300 ft. (700 m.) O.D. Beneath stones and boulders, but more particularly among moss and on rotting, but relatively still discrete, plant remains beneath boulders. Flight period: March to May. British records: February to June.

17. *Protonemura praecox* (Morton). Common: occurring along with *P. meyeri*, but more abundant. Flight period: March to May. British records: February to June.

18. *Protonemura montana* Kimmins. Rare: only recorded from the top of Knock Ore Gill among stones, boulders and moss in torrential flow at about 2400 ft. (730 m.) O.D., where, however, it was relatively numerous. Flight period: July, August. British records: August to September.

19. *Amphinemura standfussi* Ris. Common generally: abundant in the stream headwaters where it largely replaces *A. sulcicollis*. Possibly the second most abundant species in the area. Amongst gravel, small stones, moss and plant-remains. Flight period: June, July. British records: June to September.

20. *Amphinemura sulcicollis* (Stephens)*. Common: occurs along with *A. standfussi* particularly at lower levels although one small (1·5 mm.) nymph was taken from a limnocrene limestone spring. Flight period: May, June. British records: April to August; also recorded in September by Corbet (1959).

21. *Nemoura erratica* Claassen. Common: at least to 2300 ft. (700 m.) O.D. On bare stones, gravel, boulders, vegetation. Under all conditions of flow. Flight period: April to June. British records: February to September.

22. *Nemoura cambrica* (Stephens). Common: up to 2200 ft. (670 m.) O.D. More numerous than *N. erratica* particularly in the lower reaches of the streams early in nymphal life. On all substrata and often among plant-remains. Beneath stones in pools and trickles on bare eroding peat and in bog pools beside streams, particularly at higher altitudes. Flight period: April to June. British records: April to June.

23. *Nemoura cinerea* (Retzius). Common: up to 2500 ft. (760 m.) O.D. Chief populations in tarns and bog pools with much vegetation (*Sphagnum* spp.), and widespread over the Reserve in such conditions. Also present in mossy trickles at the stream sources. Flight period: April, May. British records: March to September.

24. *Nemoura avicularis* Morton. Rare: nymph only taken once in a cut-off, almost stagnant pool beside the Tees at 1600 ft. (490 m.) O.D. among a thick growth of *Batrachospermum* sp. Flight period: not observed.

25. *Nemurella picteti* Klapalek. Frequent: at the higher altitudes. Only in mossy trickles, principally at the sources of streams. Flight period: not observed.

### III. Comparison of Habitat Preferences

Distribution and habitat requirements have been described by previous authors, particularly by Hynes (1941) in Britain, Brinck (1949) in Sweden and Aubert (1946) in Switzerland. It is of value to compare the habitat data presented here with the findings of these authors. The absence of a reference to Brinck (1949) or Aubert (1946) indicates that the species was not recorded by them.

1. *Perlodes microcephala*: Hynes records nymphs to 1200 ft. (365 m.) O.D. in the Lake District (cf. 2300 ft. i.e. 700 m. at Moor House) and adults (1 female) at 2000 ft. (610 m.) O.D. The nymphal habitat described is similar to that in which the nymphs are found at Moor House. Percival and Whitehead (1929) state that the species is relatively abundant among moss on stones. This was not observed on the Reserve, possibly because of the paucity of moss-bearing stones over most of the range of *Perlodes microcephala*. Aubert records the species from gravel in fast streams up to 2000 ft. (600 m.) O.D. and Hubault (1927) from stony torrents of the French Alps up to 6000 ft. (1900 m.) O.D.

2. *Diura bicaudata*: Hynes (1941) did not find this species in association with *Perlodes microcephala*. He did, however, find them together in a Welsh stream (Hynes, 1961), but at the highest station (1440 ft. = 440 m. O.D.) only *D. bicaudata* was found.

Hynes records it from lakes and streams (above 750 ft., i.e. 230 m.) in England and Ireland and in streams almost at sea-level in the Isle of Man (1952). This species is of northern distribution occurring in both Eurasia and the north of Canada (Brinck, 1949; Ricker, 1944; Hynes, 1952). Hynes' (1952) observations on this species in the Isle of Man suggest that its wider general distribution in Britain is limited by competition or predation.

3. *Dinocras cephalotes*: The distribution of the nymphs of this species within the Reserve agrees fairly well with that found by Hynes and Brinck except that, contrary to Hynes' findings,

this species does not extend as far into the head-waters as does *P. bipunctata*. However, Aubert records it at 2700 ft. (800 m.) O.D. and over, and Brinck found it in high, mountain lakes.

4. *Perla bipunctata*: The distribution at Moor House agrees with that found by Hynes but the larger nymphs (2nd and 3rd year) are only found in the larger, lower watercourses. Hynes states that this species is present up to the sources of mountain streams where the substratum is suitable.

5. *Isoperla grammatica*: Hynes does not record this species above 1000 ft. (300 m.) O.D., but Corbet (1959) records it to 2200 ft. (670 m.) O.D. in the Scottish highlands (cf. 2400 ft. (735 m.) O.D. at Moor House). The species is most numerous on the western slopes of the Reserve and adults were frequently seen at about 2500 ft. (760 m.) O.D. being carried up-wind aeross the ridge and on to the eastern slopes. It is probable that the population of the eastern slopes receives a steady build-up from this source. It occurs in lowland rivers in Britain, and Brinck describes this species as having the widest ecological amplitude of any member of the Setipalpia in Sweden, occurring in southern streams and rivers, northern running waters and high mountain lakes, so that it would not appear to be an unusual inhabitant at this altitude. Aubert describes the species as occurring up to 4600 ft. (1400 m.) O.D. In Britain, however, it would seem to be more abundant in lowland streams.

6. *Chloroperla torrentium*: Recorded by Aubert up to 3000 ft. (900 m.) O.D.

7. *Chloroperla tripunctata*: The nymph was taken at 1940 ft. (590 m.) O.D., (cf. Hynes 1200 ft., i.e. 370 m. O.D. and Corbet (1959) 1600 ft., i.e. 490 m. O.D.). The habitat agrees with that of Hynes for the Lake District except for the altitudinal differences. Recorded by Aubert in all water courses up to 6500 ft. (2000 m.) O.D.

8. *Taeniopteryx nebulosa*: Brinck describes this species from southern Swedish rivers, but it also occurs in northern water courses and high mountain lakes. It is recorded as abundant in deep rivers with partly soft bottoms. Hynes describes it as an inhabitant of sluggish rivers, and states that the nymph is apparently always coated with mud. On the Moor House Reserve it lives in sluggish waters but it is also found in the main streams, sheltering beneath stones and boulders in fast-flowing regions, for example below waterfalls. In this particular environment the nymphs were never coated with mud. From its general distribution it is obviously a species capable of tolerating slow-flowing, eutrophic waters with varying temperature and dissolved oxygen concentration. Aubert describes it as common in the Alps wherever there are large rivers.

9. *Brachyptera risi*: Described by Brinck as occurring in southern Swedish streams, and most water-courses with clear water and moderate current. It is rare in the north of Sweden,

where it is seldom or never found in swift rivers and 'jokks' (mountain torrents). Aubert records it from lakes (L. Geneva) and describes it as abundant along water-courses below 3000 ft. (900 m.) O.D.

Hynes describes the species as present in small streams and rivers in the Lake District, up to 1400 ft. (430 m.) O.D. (one adult taken). Hill (1946) records the species from a rheocrine spring, with fairly rapid flow at 1000 ft. (305 m.) O.D. in the Tay Basin (Scotland), Corbet (1959) found it in streams to 1000 ft. (305 m.) O.D. in Raasay, Westerness, Argyll, mid Perth and Angus and Mr. W. L. Templeton (pers. comm.) to 1600 ft. (490 m.) O.D. in Angus (Scotland). Butcher *et al.* (1937) record it from the Tees above 500 ft. (150 m.) O.D. but it would seem to be a species perhaps rather more typical of 'lowland' (below 1500 ft., i.e. 460 m. O.D.) than of montane streams (above 1500-2000 ft., i.e. 460-610 m. O.D.) in Britain.

10. *Capnia vidua*: Adults have been recorded from the following five areas in Britain: Easterness, Westmorland and N. Lancashire, Lancashire mid., N.W. Yorkshire, N.E. Yorkshire and Cheshire (Hynes, 1958) and nymphs from one locality in Perthshire by Mr. N. C. Morgan (pers. comm.). Aubert describes it as a "true-seeming boreo-alpine species" occurring in mountain torrents up to 8000 ft. (2500 m.) O.D.

11. *Leuctra nigra*: Brinck records this species as characteristic of small stony streams (trickles) with a supply of sub-soil water and an accumulation of detritus. It also occurs in northern lakes. Hynes records the species from several small, stony streams in silted localities (pools, leaf-packets) and from the silted shores of Windermere. Too few nymphs were taken at Moor House to provide a precise description of its preferred habitat on the Reserve. Common in the Alps to 5000 ft. (1500 m.) O.D. (Aubert).

12. *Leuctra inermis*: Aubert records this as the most abundant Swiss stonefly, present in rivers below 5000 ft. (1500 m.) O.D.

13. *Leuctra fusca*: Recorded by Brinck from high mountain lakes and described by Aubert as very common up to 2000 ft. (600 m.) O.D.

14. *Leuctra hippopus*: Stated by Brinck to occur chiefly in small eutrophic forest streams as well as scattered specimens being taken in rivers, jokks and high mountain lakes. Hynes records it chiefly from small, stony streams up to 2000 ft. (610 m.) O.D., and also in rivers and on stony lake shores, whilst Corbet (1959) records it from streams and lochans up to 2250 ft. (685 m.) O.D. in the Scottish Highlands. It was recorded up to 2500 ft. (760 m.) O.D. at Moor House in mossy trickles but was not markedly present in plant debris as observed by Hynes. Aubert records it as very common in rivers of moderate flow in the Alps, but not above 2600 ft. (800 m.) O.D.

15. *Leuctra moselyi*: Hynes records this species from small, stony streams up to 2000 ft. (610 m.) O.D. in the Lake District and Corbet (1959) records it only up to 1200 ft. (365 m.) O.D. in the Scottish Highlands. It is recorded as rare in Britain, although at Moor House it is extremely common. Aubert describes it as present more in the plains than in the mountains although it does occur up to 5000 ft. (1500 m.) O.D.

16. *Protonemura meyeri*: Brinck classifies this species as occurring typically in southern Swedish streams although occurring in all types of water-courses throughout Sweden, preferring clear-water streams with stable substrata, moss on stones, and a considerable supply of sub-soil water. Hynes records it chiefly from small, stony streams. In rivers it was entirely confined to moss, occurring in leaf-packets and under stones and found up to 2000 ft. (610 m.) O.D. This agrees with the habitat preference of this species on the Reserve except that nymphs were taken up to 2300 ft. (700 m.) O.D. (cf. Corbet (1959) 2500 ft. (760 m.) O.D. in the Scottish Highlands). Hill (1946) records nymphs from a pond in Scotland but this would seem to be an exceptional habitat. Aubert records it as localised near streams with dense moss-growth up to 3000 ft. (900 m.) O.D.

17. *Protonemura praecox*: Hynes records this species chiefly from small, stony streams up to 2000 ft. (610 m.) O.D. On the Moor House Reserve it has a similar distribution and similar habitat preferences to *P. meyeri,* extending up to the stream heads (2400 ft., i.e. 730 m. O.D.). From its general distribution in Britain (mountain districts of Northern England and Wales mainly, but also in Scotland and one record from Ireland) it would appear to be stenothermal and more typical of montane habitats than *P. meyeri* which extends to southern England and also Ireland. Consequently it might be expected to be found on the Reserve at any altitude which provides suitable habitat conditions. Aubert found this species in stony rivers and torrents, particularly below 2000 ft. (600 m.) O.D.

18. *Protonemura montana*: Adult first taken by Hynes and described by Kimmins (1941). Nymphs taken the same year were described by Kimmins in 1943. The specimens were found under flat stones in a small stream (source) at about 1700 ft. (520 m.) O.D. in the Lake District (beneath Coniston Old Man). It has since been recorded from Ben Nevis (Kimmins—pers. comm.) as well as from other places, its total known distribution to date being from Cumberland, Westmorland, Lancashire, Inverness-shire, Aberdeenshire and Ross (Hynes, 1958). This species was only recorded from one stream on the Moor House Reserve, a torrential stream composed solely of sub-soil water flowing over moss and large stones and boulders. The nature of the source of this stream causes the water to be at a low temperature throughout the year in the headwaters, as does the fast and relatively great volume of flow.

19. *Amphinemura standfussi*: Brinck describes this species from small streams and trickles in southern Sweden, with cold water, rarely in other streams and usually in leaf-packets. In northern Sweden it is found in trickles, streams, rivers, jokks and abundantly in lakes. It is common on the Reserve, occurring throughout the altitudinal range of the eastern watershed streams. Kimmins (1943) records it from the source of Rydal Beck (Lake District) under stones at an altitude of 2000-2200 ft. (610-670 m.) O.D. but it was not found at lower altitudes. The present distribution of this species, as far as is known, shows it to be most generally distributed over N. Wales. It is also recorded from S. England, Yorkshire and Scotland (Hynes, 1958).

20. *Amphinemura sulcicollis*: Regarded by Brinck as typical of southern Swedish streams, chiefly clearwater streams, and rivers with stony bottoms and fairly constant flow of water. It does, however, occur in all water bodies in northern Sweden. Hynes describes this species chiefly from small, stony streams. The general distribution of the species on the Reserve was similar to that of *A. standfussi* but from its distribution in the British Isles it evidently has a much greater temperature tolerance range than *A. standfussi*. Aubert describes it as having a wide distribution in the Alps, but not above 5000 ft. (1500 m.) O.D.

21. *Nemoura erratica*: According to Brinck, this species occurs in small eutrophic forest streams but it is also present in similar larger streams becoming rare towards the north of Sweden. Hynes records the species as 'common in only one small, stony stream in the Lake District' but two specimens were taken 'in streams at high altitudes' and one adult was recorded at 1500 ft. (460 m.) O.D. The stream in which the species was abundant was described as only two to three feet wide . . . full of dead leaves and twigs amongst which the nymphs were found in large numbers. Hill (1946) recorded the species from a pond in the Tay valley (Scotland). This species is quite common in the streams of the Reserve.

22. *Nemoura cambrica*: Hynes describes this species chiefly from small, stony streams, typically in leaf-packets, up to 1400 ft. (430 m.) O.D. It was recorded from almost all streams on the Reserve to at least 2000 ft. (610 m.) O.D.

23. *Nemoura cinerea*: Brinck describes this species as ubiquitous in Sweden with a very wide ecological amplitude, occurring in almost all freshwater bodies and able to exist in water with low dissolved-oxygen content (30-40% saturation). Hynes records it from trickles and tarns, but also from vegetation and leaf-packets in lowland streams (in the Lake District). This species was never encountered in running waters on the Reserve, except in mossy trickles at the stream heads. It was most numerous in tarns and bog-pools, extending up to 2500 ft. (760 m.) O.D. Corbet (1959) records the species up to 3000 ft. (915 m.) O.D. in Scotland. Aubert describes it as ubiquitous in the Alps, present up to 5000 ft. (1500 m.) O.D.

24. *Nemoura avicularis*: Described by Brinck as widespread in southern Swedish streams with scattered specimens from the rivers. In northern Sweden it is common in all waters, but commonest in mountain lakes. Hynes records it from vegetation on stony, lake shores, vegetation in sluggish rivers and on one lake outflow. The single specimen recorded from the Reserve was in a similar habitat. The breeding population of this species in the area is probably centred on the reach of the Tees (the Weel) above Cauldron Snout which approximates in many ways to a dystrophic mountain lake.

25 *Nemurella picteti*: Described by Brinck as the only species apart from *N. cinerea* that can live in waters of constantly low oxygen content.

## IV. Flight Periods

The flight-periods of the adults of the Moor House species on the eastern slopes of the Reserve are given in II above, along with those recorded elsewhere in the British Isles (Hynes, 1940; Kimmins, 1950; Corbet, 1959; Hynes, 1958). Comparisons reveal that emergences at Moor House did not begin before March and ended in October. The following species which have been recorded previously as beginning emergences in February were not observed to emerge until March on the Reserve: *T. nebulosa, L. hippopus, P. meyeri, P. praecox.* *Nemoura erratica* did not emerge until two months later than the earliest emergence date elsewhere. These late emergences are to be expected in view of the low temperatures prevailing at Moor House. However, several species at Moor House showed a more extended flight period than has previously been recorded: *P. montana* imagines were taken earlier (1 July) than recorded elsewhere and may have a more extended flight period, as has *Leuctra moselyi*, active three months longer, and *Capnia vidua* active one month longer, than previous records indicate.

## V. Summary

Twenty-five of the thirty-five British species of Plecoptera have been recorded from the Moor House National Nature Reserve and these included *Capnia vidua, Leuctra moselyi, Protonemura montana* and *Amphinemura standfussi*, which have been described as rare in Britain by previous authors.

The distribution of nymphs on the Reserve is described. Most of the adults had shorter flight periods than those given in other British records, but imagines of *Leuctra moselyi* and *Capnia vidua* were found over more extended periods than was expected from previous records.

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